



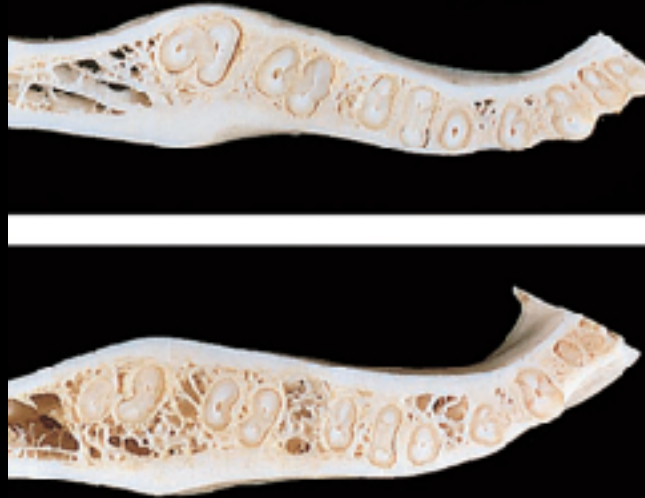
Treatment options of furcation involved teeth

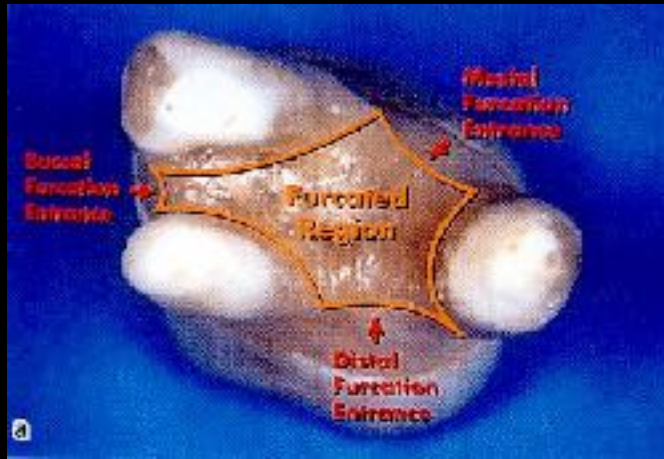


Pal Nagy, DMD
Dept. of Periodontology

Introduction - Prevalence

- furcation (is the area located between individual root cones) = locus minoris resistentiae

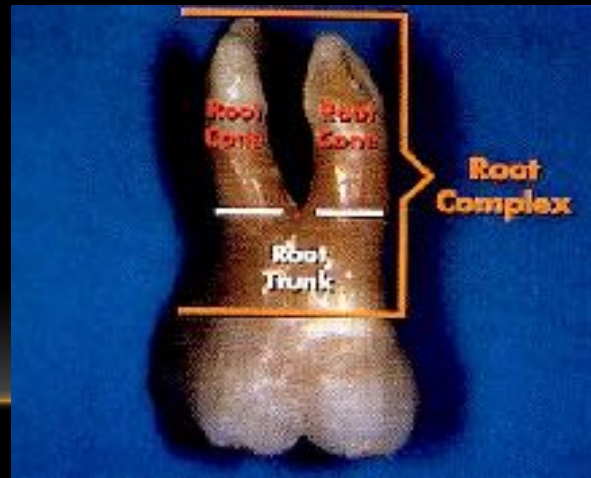




Root trunk:
undivided region of
the root.



Prognosis



Maxillary molars

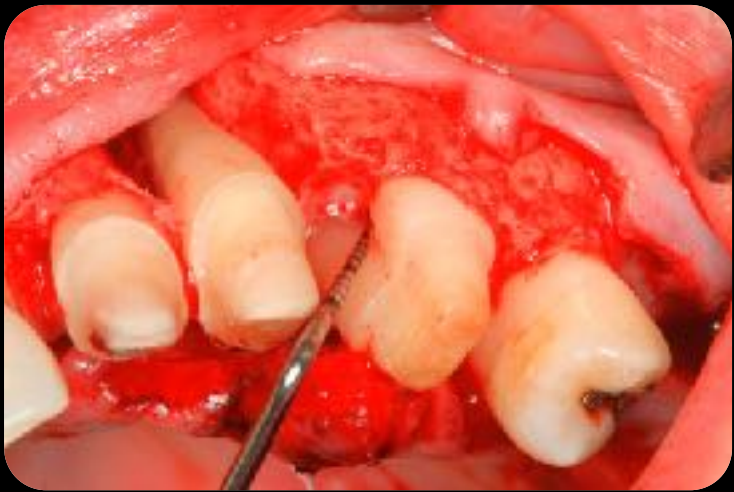
- MB root: - kidney shaped cross section in general, in a more buccal position as DB root, → fenestration → development of recession
 - usually meet the size of palatal root, or longer
 - difficulties in root canal treatment
- P root: - wide round shaped cross section
- First molars usually have shorter root trunks as second molars. → 16,26 are the most often affected, 3X more than lower molars



Maxillary praemolars

- in 40% of the cases maxillary first praemolars have 2 roots with furcation in mesio-distal direction → difficulties in cleaning
- In 78% of the cases concavity on buccal root
- furcation usually located in the middle or apical third of the root
- **Pseudofurcation (furrows)** often occurs, that makes the diagnosis and periodontal treatment particularly difficult.
- Average distance between CEJ and furcation ~ 8 mm





Mandibular molars

- Almost always 2 roots with bucco-lingual furcation, kidney shaped cross-section, root trunk of the first molar is usually shorter than second molar
- M root: wider, longer, „hour-glass” cross section, 2 root canals

↓
difficulties in cleaning and prosthetic rehabilitation

- D root: ovoid cross section, usually 1 wide canal
more suitable for prosthetic rehabilitation
(5 – 6D – 7D bridge)



Mandibular molars

- Roots have convergence distally (divergence and angle of separation decrease)



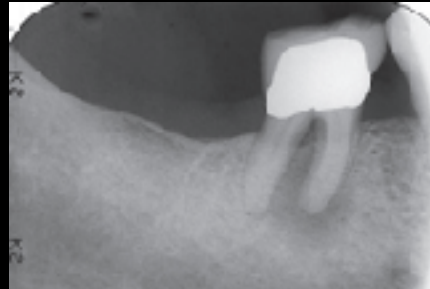
primer endodontic lesion,
furcation can be involved



endoperiodontal lesion



development of periodontal
abscess



Mandibular molars

the lingual entrance of the furcation is frequently found more apical to the CEJ (>4mm) than the buccal entrance (>3mm) (the root trunk is shorter buccally)



molars with shorter root trunk could be involved sooner



If the lingual entrance is affected, usually untreatable, because of lack of attached gingiva



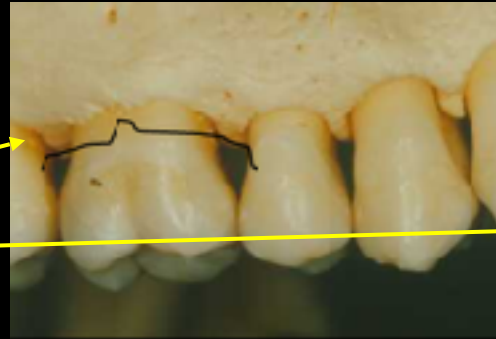
treatment: dissection or extraction



Etiology

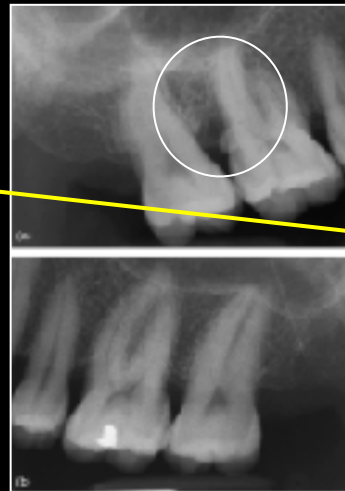
Enamel pearls, enamel projections

- Enamel pearls and enamel projections are derived from Hertwig's epithelial root sheath under CEJ.



- Enamel projections: lack of connective tissue attachment

- Enamel pearls: occur in 1-10% especially at the furcation area of maxillary second and third molars. They are often isolated, containing enamel and dentin, in some of the cases they contain pulpal tissues as well.



Etiology

Hyperocclusion in the curve of Spee



Wisdom tooth extraction in early age

- eruption of mandibular wisdom teeth often result in crowding of 1. and 2. mandibular molars



- resulting in hyperocclusion in the curve of Spee

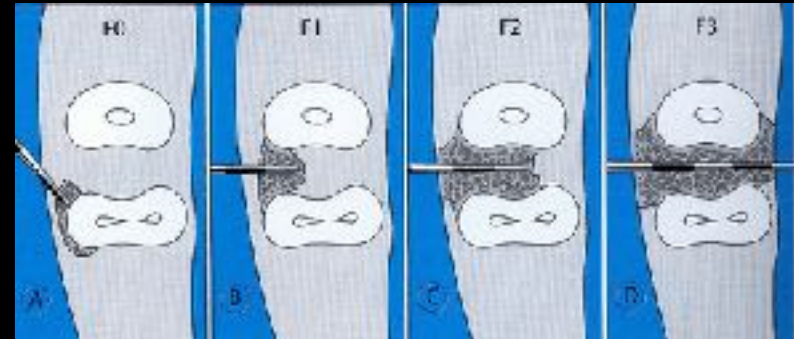
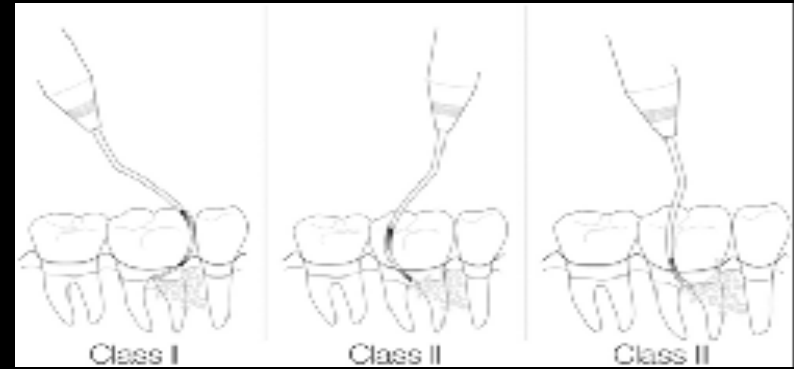


early extraction of lower 8 is beneficial

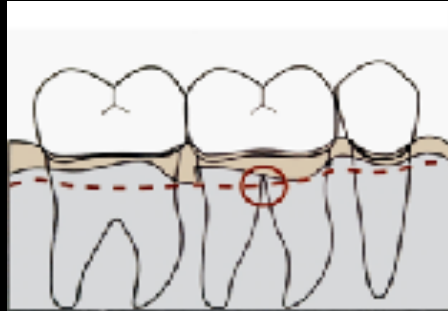


Classification of furcation defects I.

- with Nabers-probe - curved, colour-coded and is marked in millimeters
- based on **horizontal penetration** (Hamp et al, 1975)
- **Degree 0**: the area of furcation is not accessible
- **Degree I**: horizontal loss of periodontal support **not exceeding one third of the width** of the tooth (or 3 mm)
- **Degree II**: horizontal loss of periodontal support **exceeding one third of the width of the tooth** (3 mm), but not encompassing the total width of the furcation
- **Degree III**: horizontal **“through-and-through”** destruction of the periodontal tissues in the furcation area



Classification of furcation defects



Nabers-probe

F0



F1

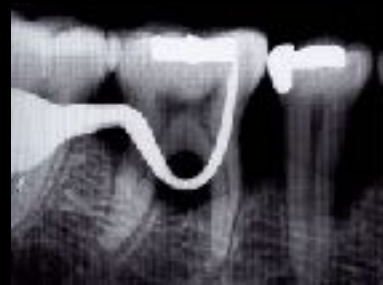


Classification of furcation defects

F2

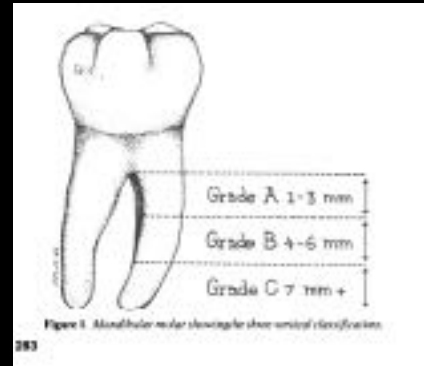
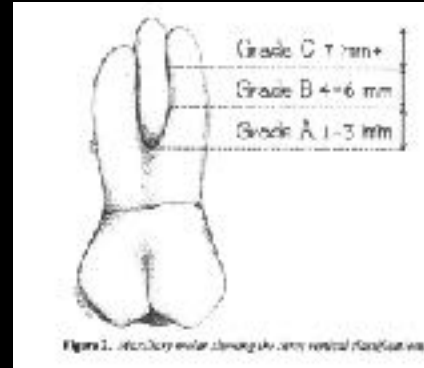


F3



Classification of furcation defects II.

- **Based on horizontal and vertical bone loss** (Tarnow et al. 1984)
- between the roof of the furcation and the existing bone
- Considers the degree of **both vertical and horizontal bone loss** more effective in evaluating the prognosis
- A: 1-3 mm
- B: 4-6 mm
- C: 7 mm <



Classification of furcation defects III.

P
R
O
G
N
O
S
I
S



Fig 2a - Type A root trunk (yellow crown) with Class I furcation defect - horizontal attachment loss of Class I (A)



Fig 2b - Type A root trunk with Class I furcation - Accidental attachment loss of Class I (B)



Fig 2c - Type A root trunk with Class II furcation - horizontal attachment loss of Class II (A)



Fig 3a - Type B root trunk (yellow crown) with Class I furcation defect - horizontal attachment loss of Class I (A)



Fig 3b - Type B root trunk (yellow crown) with Class II furcation - horizontal attachment loss of Class I (B)



Fig 3c - Type B root trunk (yellow crown) with Class II furcation - horizontal attachment loss of Class II (A)



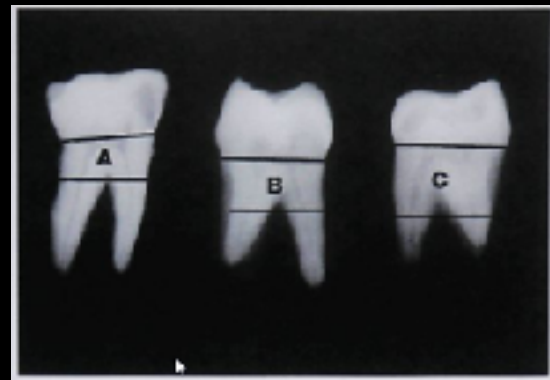
Fig 4a - Type C root trunk (red crown) with Class I furcation defect - horizontal attachment loss of Class I (A)



Fig 4b - Type C root trunk (red crown) with Class II furcation defect - horizontal attachment loss of Class I (B)

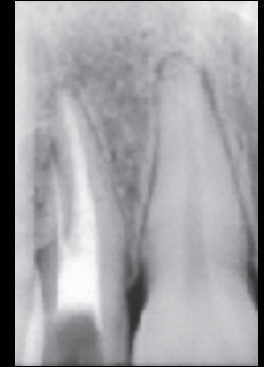


Fig 4c - Type C root trunk (red crown) with Class III furcation defect - horizontal attachment loss of Class III (A)



Factors influencing treatment outcomes

- Anatomical factors (supernumerary roots)
- Spreading of the defect
- Number of affected furcations within the tooth and the quadrant
- Processes in pulp
- Anatomical variations (enamel pearls, enamel projections, supernumerary roots)
- Tooth mobility
- Plaque retentive factors
- Trauma from occlusion (differential diagnosis)!!

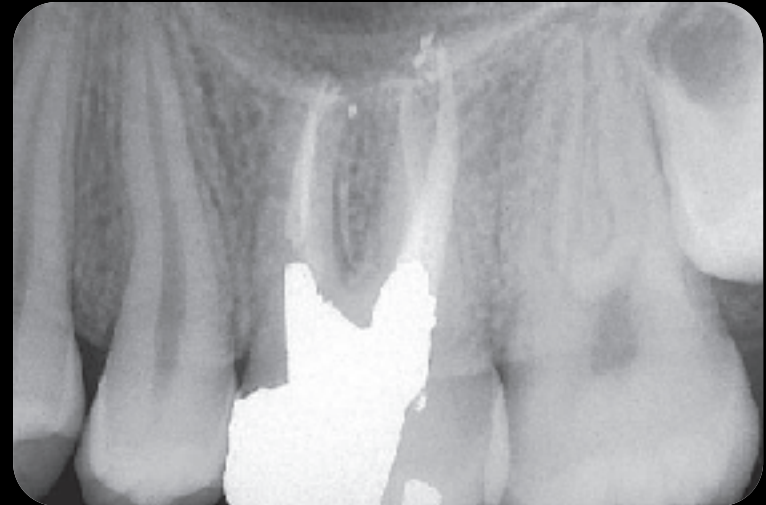
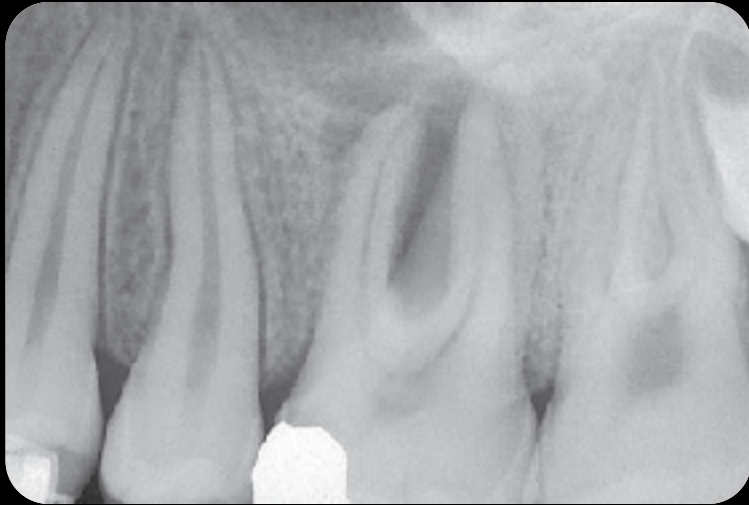


Differential diagnosis -Trauma from occlusion

- could enhance susceptibility of periodontium to plaque-induced infection
- The tooth may exhibit increased mobility!!
- Occlusal adjustment must always precede periodontal therapy!
- If the defect has occlusal origin, following occlusal correction, the defect could disappear within weeks



Differential diagnosis - Endo-periodontal lesion



Treatment options of furcation lesions

Grade I

- Scaling, root planning
- Furcation plasty
- Regeneration?

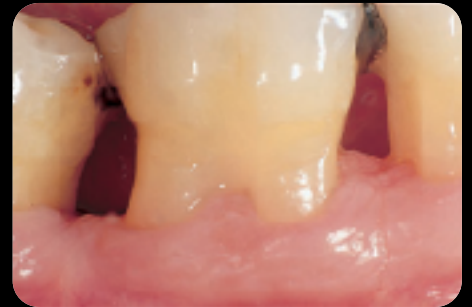
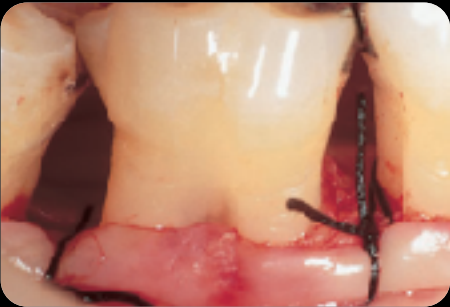
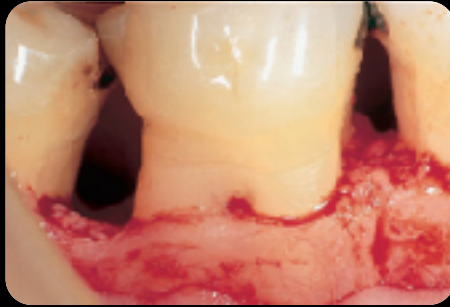
Furcation plasty

Therapy

- 1. the dissection and elevation of a soft tissue flap – to obtain access
 - 2. Scaling, root planning, the removal of the inflammatory soft tissue from the furcation area
 - 3. **Odontoplasty**: the removal of crown and root substance in the furcational area to eliminate the horizontal component of the defect and to widen the furcation entrance.
 - 4. **Osteoplasty**: the recontouring of the alveolar bone crest in order to reduce the buccal-lingual dimension of a bone defect
 - 5. the positioning and the suturing of the mucosal flaps at the level of the alveolar crest in order to cover the furcation entrance
- ↓
- Following healing a „papilla-like” tissue should close the entrance



Furcation plasty



Treatment options of furcation lesions

Class II.

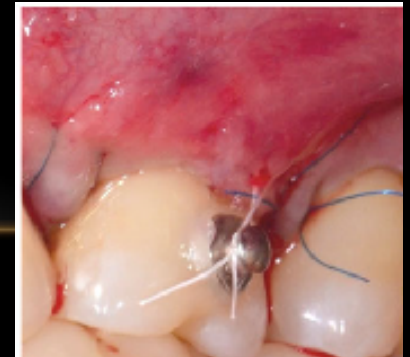
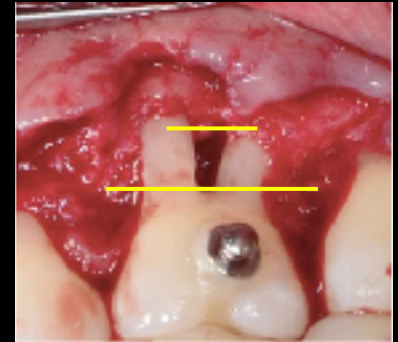
- (Furcation plasty)
- REGENERATION (GTR, EMD, xenografts, PRF)
- Alternatives: Tunnel preparation, root separation and resection (RSR)
- Extraction

REGENERATIVE STRATEGIES- FURCATION LESIONS

- Furcation class I: complete regeneration is possible
- Furcation class II: can be converted to furcation class I.
- Furcation class III: histologically regeneration was not proven in human
- the lingual site is limited!

Regenerative strategies: combined therapy is suggested

- EMD + Graft
- EMD + Graft + GTR
- rhPDGF + Graft



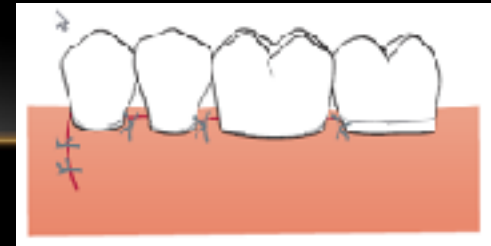
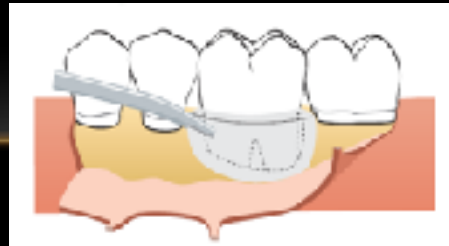
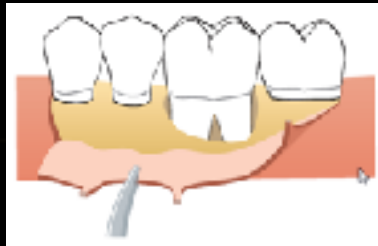
Regeneration - GTR technique

- using the barrier membranes prevents the apical migration of epithelium

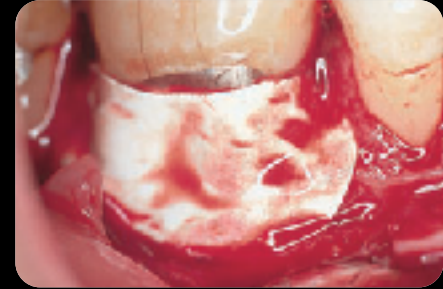
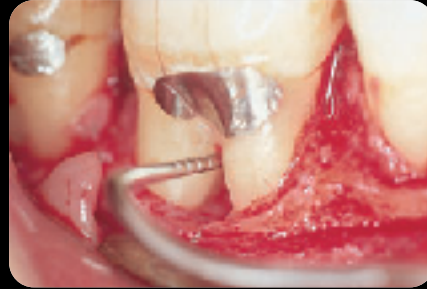


may allow (guide) periodontal ligament cells to repopulate the detached root surface (Gotlow et al. 1986).

- Technique sensitive procedure early exposure of the membrane and the fornix
- The predictability of this treatment outcome improves following GTR therapy if the *interproximal* bone is located at a level which is close to the CEJ of the approximal surface („key-hole type”)



GTR-technique – non resorbable membrane



a buccal degree II furcation-involved mandibular first molar.



removal of the membrane 6 weeks later

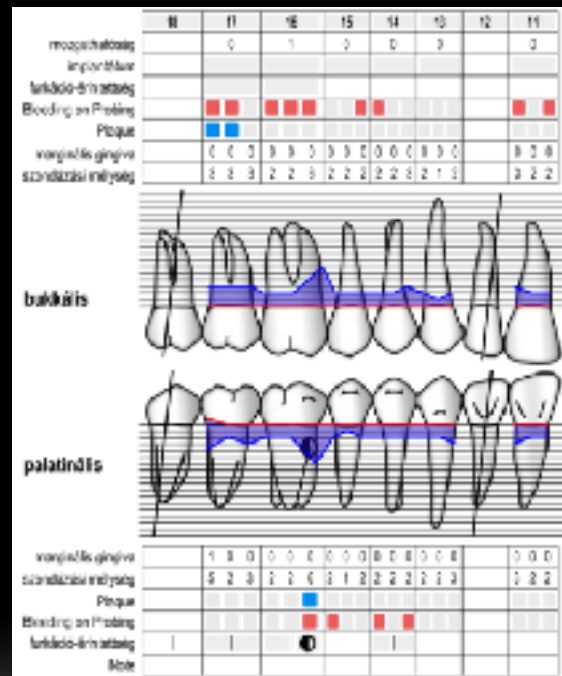
1 year later

Regeneration - EMD

Enamel matrix proteins (Emdogain, Straumann, Basel, Switzerland) compared with GTR technique

- A multicenter randomized controlled clinical trial, with paired mandibular molars with buccal degree II furcation involvements (Jepsen et al. 2004):
- Mean reduction in the open horizontal furcation depth of 2,8 mm for EMD treated sites and of 1,8 mm for GTR-treated defects
- In addition the frequency of **complete closed furcation** defects was higher for **EMD** sites (**8/45**) than for **GTR** sites (**3/45**).
- It was concluded that both treatment modalities resulted in significant clinical improvements although the EMD method provided (1) greater reduction of the furcation depths, (2) a smaller incidence of post-operative pain/swelling, and (3) less gingival recession (Meyle et al. 2004) as compared to GTR therapy.

Regeneration - EMD, MPPF



Cortellini P, Prato GP, Tonetti MS. The modified papilla preservation technique. A new surgical approach for interproximal regenerative procedures. J Periodontol. 1995 Apr;66(4):261-6.

Sculean A, Windisch P, Döri F, Keglevich T, Molnár B, Gera I. Emdogain in regenerative periodontal therapy. A review of the literature. Fogorv Sz. 2007 Oct;100(5):220-32, 211-9.

Dr. Kövér Krisztián



Cortellini P, Prato GP, Tonetti MS. The modified papilla preservation technique. A new surgical approach for interproximal regenerative procedures. *J Periodontol.* 1995 Apr;66(4):261-6.

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Regeneration - EMD



Cortellini P, Prato GP, Tonetti MS. The modified papilla preservation technique. A new surgical approach for interproximal regenerative procedures. *J Periodontol.* 1995 Apr;66(4):261-6.

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Regeneration - combined therapy I: GTR-technika + xenograft + EMD



Regeneration - combined therapy I: GTR-technika + xenograft + EMD



12 months later



Dr. Nagy Pál

Regeneration - combined therapy II: GTR-technique + xenograft + EMD



Application of Bio-oss, Bio-Gide membrane and EMD in the defect



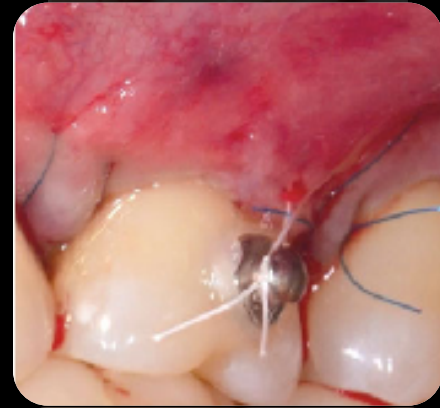
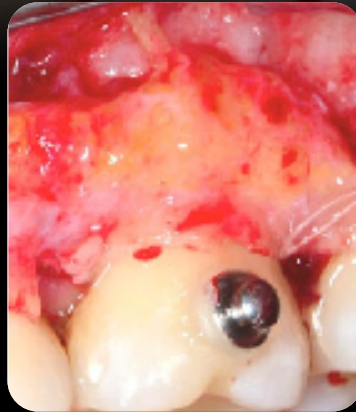
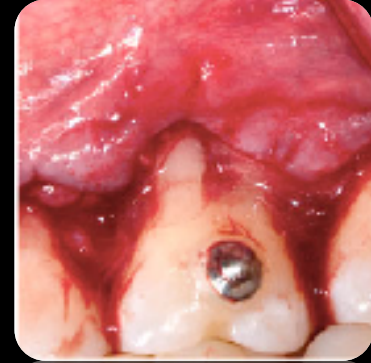
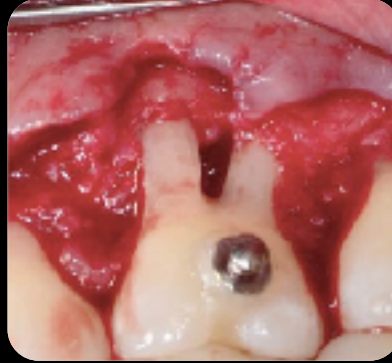
Application of Bio-oss, Bio-Gide membrane and EMD in the defect



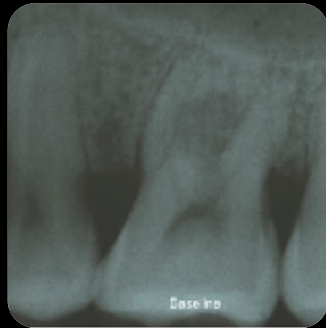
1 year later



Regeneration - combined therapy III: Xenograft + EMD+ SCTG



Regeneration - combined therapy III: Xenograft + EMD+ SCTG



Baseline

1 year later

2 year later

Treatment options of furcation lesions

Class III

- Tunnel preparation
- Root separation (hemisection) and resection (RSR)
- Root separation (premolarisation = bicuspidation)
- Extraction

Tunnel preparation

- Used to treat deep degree II and degree III furcation defects
- Includes the surgical exposure and management of entire furcation area of the affected molar
- Mostly at mandibular molars!!!
- Can be offered at molars which have a **short root trunk, wide separation angle and long divergence between the roots**
- Following the reflection of the flap, the granulation tissue in the defect is removed
- Hard tissue resection (**osteoplasty**) – to allow access for cleaning devices
- The flaps are apically positioned
- for patient with **very good manual skill!!!**
- Postoperativ: often root sensitivity => local fluoride varnish (Hamp et al,1975)
- Disadvantage: risk for root caries and root resorption (Feres et al. 2006.)
- Advantage: not needed endodontic treatment



Tunnel preparation



46 FIII

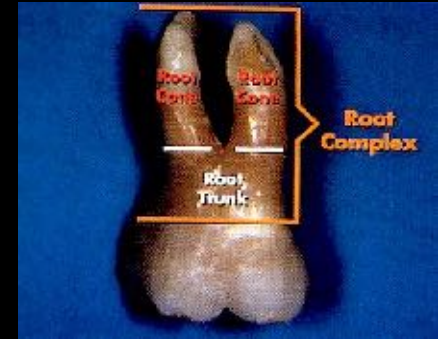
Root separation and resection (RSR) - hemisection

- Radical, if there isn't other option for save of the tooth
- Before the treatment : lege artis root canal treatment
- 2 steps: separation and extraction
- temporary prosthetics solutions with occlusal correction
- 2-3 months observation period – until the end of the early healing
- definitive prosthetic solution 8-12 months later after the treatment

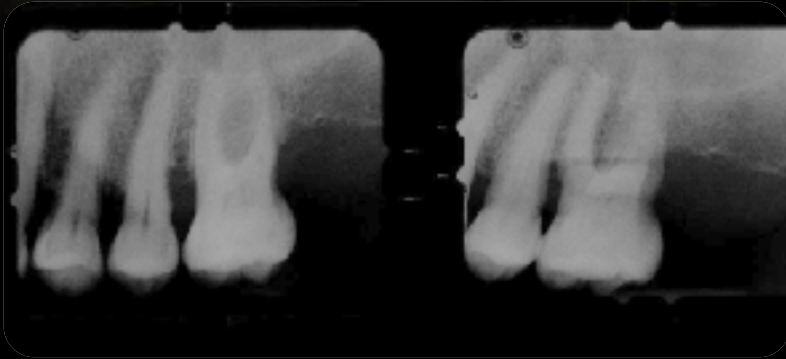


Aspects - anatomy important!

- The length of the root trunk (short root trunk may be favourable for RSR)
- The divergence between the root cones (small divergence => problem with the separation, orthodontic movement?, odontoplasty)
- The length and the shape of the root cones (small, short root => prosthetic solution?)
- Fusion between root cones, pseudofurcation (maxillary premolars)
- Amount of remaining support around individual roots (long-term prognosis)
- Stability of individual roots (following root separation)
- Access for oral hygiene devices (suitable?)



Root resection



Separation and removal of DB root (#26)



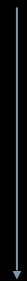
1 year later





CASE

1989



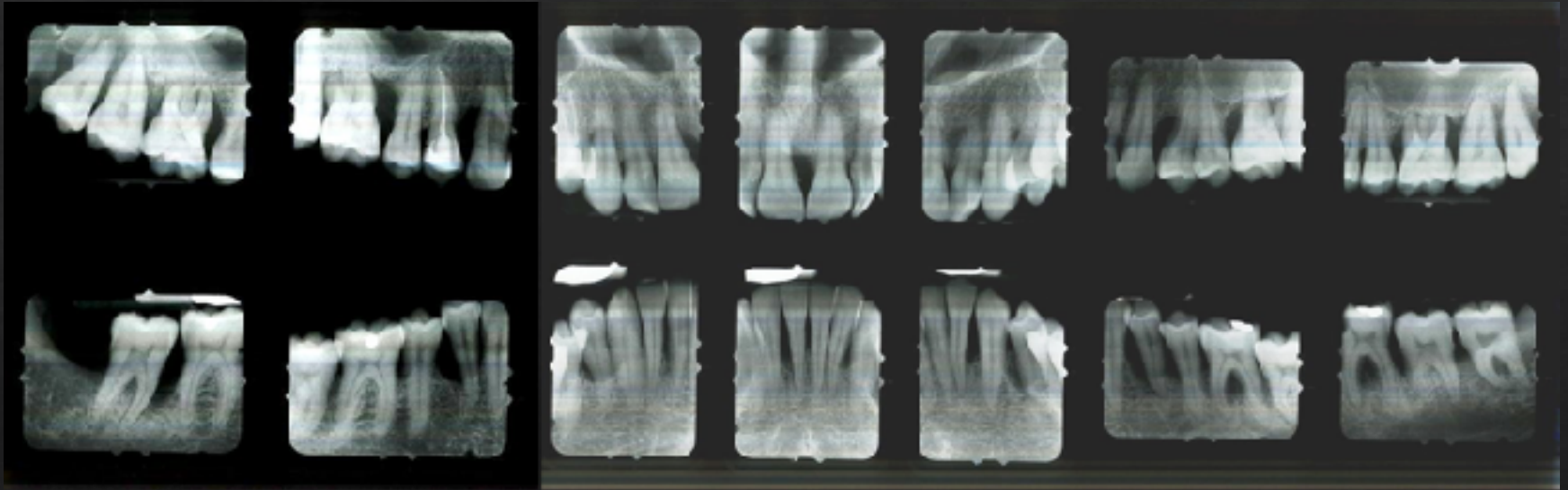
2003



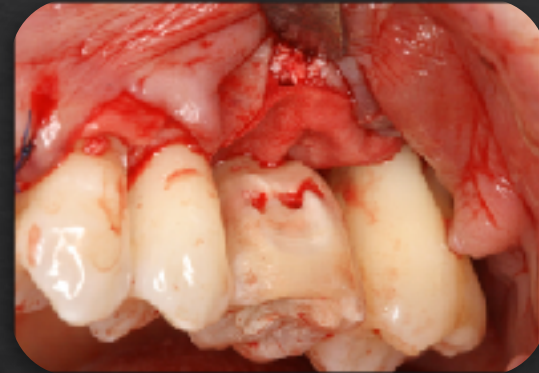
Prof. Dr. Gera István

Root resection

CASE: dissection and resection of buccal roots at teeth No. 16,26



Regenerative surgery with GTR-technique at upper left quadrant: Bio-Gide+ Bio-Oss and autologous bone (and dissection of tooth No. 26)



Carnevale G et al.: *Long term effects of root resective therapy in furcation-involved molars. A 10 year longitudinal study.*
J Clin Periodontol 1998; 25:209-214

Sculean A, Stavropoulos A, Windisch P, Keglevich T, Karring T, Gera I.: *Healing of human intrabony defects following regenerative periodontal therapy with bovine derived xenograft and guided tissue regeneration.*
Clin Oral Investig 2004; 8:70-74

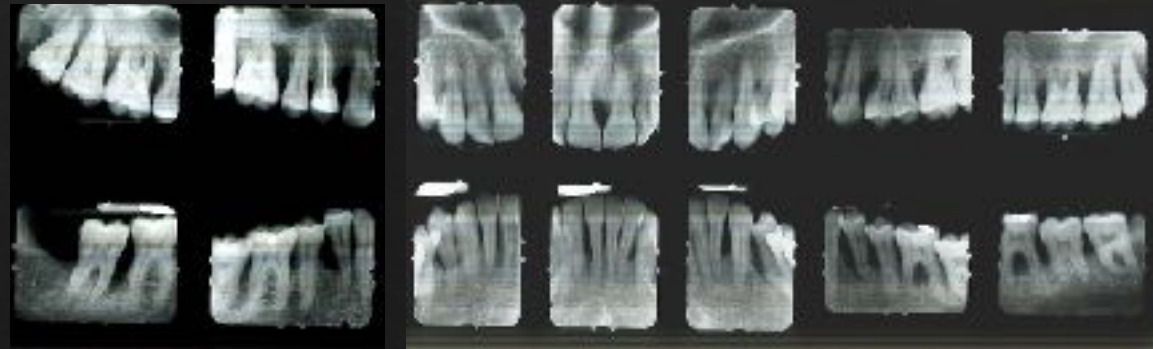
Definitive prosthetic rehabilitation



3 years later



Compared to
initial x-ray status



Premolarisation (bicuspidization)

Premolarisation: combination of tunnelisation and hemisection. none of the roots are removed, both of them take part separately in the prosthetic rehabilitation. If the roots are too close to each other orthodontic treatment can be applied to create space between them. (*Carnevale et al. 1991, 1998*)

Carnevale G, Di Febo G, Tonelli MP, Marin C, Fuzzi M. A retrospective analysis of the periodontal prosthetic treatment of molars with interradicular lesions. *Int J Periodontics Restorative Dent.* 1991;11(3):189-205.

Carnevale G, Pontoriero R, di Febo G. Long-term effects of root-resective therapy in furcation-involved molars. A 10-year longitudinal study. *J Clin Periodontol.* 1998 Mar;25(3):209-14.

Bicuspidization and root separation with resection



Premolarization at first molar and root resection at second molar

CASE – premolarisation and final prosthetic restoration of the tooth No. 36



premolarisation and final prosthetic restoration of the tooth No. 36



QR code is coming



Prosthetic rehabilitation of furcation involved teeth



Prosthetic rehabilitation of furcation involved teeth

- keeping in mind furcation entry
- Concavity of the marginal area
- Furcation entry should be cleansable!!!

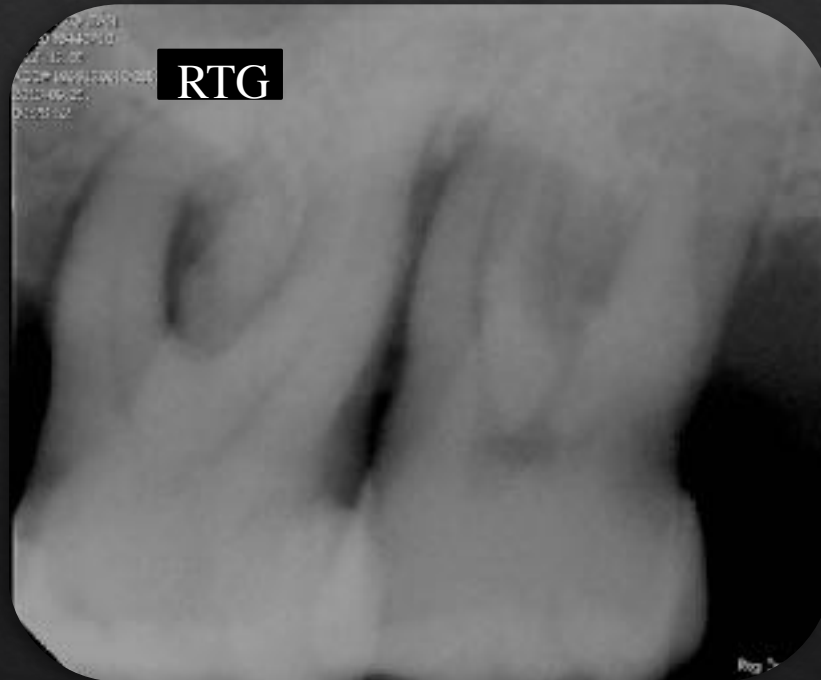


Prosthetic rehabilitation of furcation involved teeth

- Root resection (hemisection)
- Tunnel preparation
- Premolarization (bicuspidisation)

CASE: 26: root resection: DB premolarization: MB and P roots

27: root resection: P, tunnel preparation: MB and DB roots



Prosthetic rehabilitation of furcation involved teeth

- Root resection (hemisection)
- Tunnel preparation
- Premolarization (bicuspidisation)

CASE: 26: root resection: DB, premolarization: MB and P roots

27: root resection: P, tunnel preparation: MB and DB roots

RTG



1 year later



Prosthetic rehabilitation of furcation involved teeth

26: DB root resection, premolarization of MB and P roots,
27: P root resection and tunnelization of MB and DB roots



Prosthetic rehabilitation of furcation involved teeth

26: DB root resection, premolarization of MB and P roots,

27: P root resection and tunnelization of MB and DB roots

Key factors in the design of the framework in case of dissected/premolarized roots:

- **concavity of the framework at the marginal area !**
- Margin of the crown should be metal or zirconia
- the connector parts of the framework should be curved and left uncovered (without ceramic)



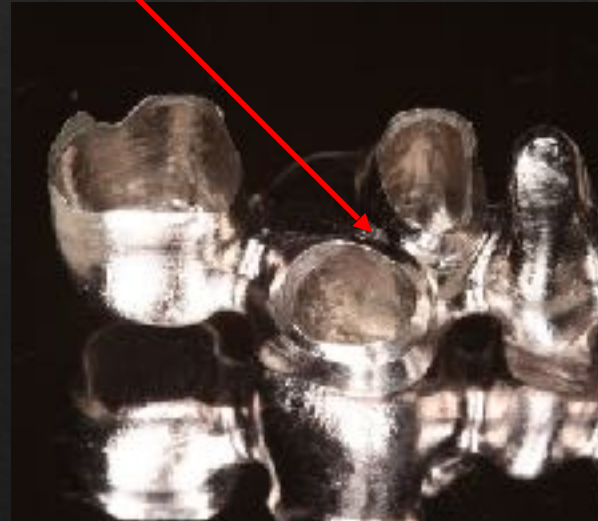
Prosthetic rehabilitation of furcation involved teeth

26: DB root resection, premolarization of MB and P roots,

27: P root resection and tunnelization of MB and DB roots

Key factors in the design of the framework in case of dissected/premolarized roots:

- concavity of the framework at the marginal area
- **Margin of the crown should be metal or zirconia**
- **Praemolarizál fognál the connector parts of the framework should be curved and left uncovered (without ceramic)**



Prosthetic rehabilitation of furcation involved teeth

26: DB root resection, premolarization of MB and P roots,
27: P root resection and tunnelization of MB and DB roots



Thank you for your attention!

